KEIL SOFTWARE

MCB167-NET Evaluation Board

High-Speed Microcontroller Board for Infineon 167 and ST10-167/168 variants with dual CAN and Ethernet Controller

User's Guide 05.2000

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Preface

This manual describes the Keil Software MCB167-NET Evaluation Board and the 166 microcontroller software development tools. The following chapters are included:

"Chapter 1. Introduction" gives an overview of this user's guide and provides a quick start table.

"Chapter 2. Setup" describes how to connect and configure the board and provides detailed information about the DIP switches and configuration jumpers.

"Chapter 3. Hardware" provides detailed information about hardware including the schematic drawings for the MCB167-NET board and the logic equations for the PLD.

"Chapter 4. Programming" gives details about how to use our tools to generate programs for the MCB167-NET evaluation board.

NOTE
This manual assumes that you are familiar with Microsoft Windows and the hardware and instruction set of the 166/167 microcontrollers.

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Chapter 1. Introduction

Thank you for letting Keil Software provide you with the MCB167-NET evaluation board and software for the 166/ST10 microcontroller family. With this kit you can generate code and then operate it on the MCB167-NET evaluation board. This hands-on process helps you determine hardware and software needs for current and future product development.

The MCB167-NET evaluation board operates with all CPU variants of the Infineon C167 and ST10-167/168. It supports the dual on-chip CAN controllers available in some devices and provides the Crystal LAN CS8900A Ethernet controller. You may implement an TCP/IP stack on this board that allows you to connect the board to the Internet via a standard 10Mbit Ethernet network.

Several program examples are provided: a simple test program that flashes the LEDs, a program that writes "Hello World" to the serial port, and a measurement recording system.

TCP/IP stack implementations for the RTX-166 real-time operating system are available from ARS Software (www.ars2000.com) and US Software (www.ussw.com).

This user's guide describes the hardware of the MCB167-NET evaluation board and contains basic operating instructions for the monitor program (Monitor-166) and the µVision2 debugger The monitor programs let you communicate between your PC and the MCB167-NET evaluation board and let you download and run your 166/167 programs.

The MCB167-NET kit includes the following items:

- MCB167-NET Evaluation Board User's Guide (this manual),
- MCB167-NET Evaluation Board,
- CD-ROM which in includes an evaluation version of the Keil C166 compiler and example programs for the MCB167-NET Evaluation Board,
- 9-pin Serial Cable.

Quick Start

Use the following list to quickly locate important information about the MCB167-NET evaluation board.

To…	See…
Connect power to the MCB167-NET board.	“Using the MCB167-NET” on page 7.
Connect the MCB167-NET to your PC.	“Using the MCB167-NET” on page 7.
Read about the default configuration settings.	“Configuring the MCB167-NET” on page 8.
Configure the tool options for the MCB167-NET board.	“Writing Programs for the MCB167-NET” on page 25.
Create a simple program to blink the LEDs.	“BLINKY Example Program” on page 28.
Write code to use the Ethernet controller.	“Other Example Programs” on page 29.
Learn more about the µVision2 IDE.	“Writing Programs for the MCB167-NET” on page 25.
Read about the DIP switch settings.	“DIP Switches” on page 9.
Read about the configuration jumpers.	“Configuration Jumpers” on page 11.
See the MCB167-NET schematics.	“Schematics” on page 18.
See the MCB167-NET PAL equations.	“PAL Equations” on page 17.

Chapter 2. Setup

The MCB167-NET evaluation board requires power and a serial connection to a PC running the µVision2 Debugger with the Monitor-166 driver. Before you start, make sure you have satisfied the following hardware and software requirements.

Hardware/Software Requirements

- A PC running Microsoft Windows-95/98, Windows NT or Windows-2000 with an available RS-232 port.
- The Keil C166 tool chain with µVision2 Debugger with the Monitor-166 driver. A pre-configured Monitor for the MCB167-NET board is included in Keil C166 Version 4.06 or higher. This package contains also several example programs for the MCB167-NET board.

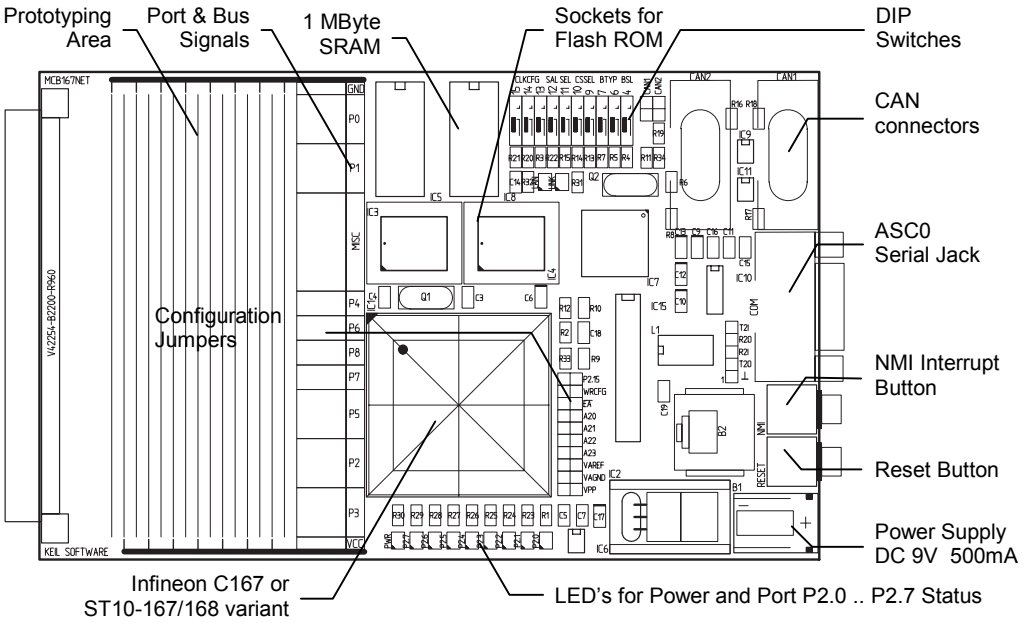
Using the MCB167-NET

To use the MCB167-NET evaluation board, you must:

- Connect the external serial port jack (COM) to a serial port on your PC using the supplied serial cable.
- Connect power using a DC 9V= 500mA power supply.

The serial cable lets your PC download program code and debug your target applications. The power cable provides power to the MCB167-NET evaluation board. The MCB167-NET does not get power from the PC via the serial cable.

The following illustration shows MCB167-NET board and the important interface and hardware components.



Configuring the MCB167-NET

You configure the MCB167-NET evaluation board with the DIP switches and the configuration jumpers. The MCB167-NET evaluation board is shipped with the following configuration:

- 20 MHz internal CPU clock, 3 chip select signals, 4 segment address lines.
- enabled bootstrap loader for downloading the debug monitor,
- enabled CAN drivers and CAN bus termination resistors,
- 5V reference voltage for the A/D converter.

The default DIP switch settings are shown in the following table.

Switch	CLKCFG			SALSEL		CSSEL		BTYP		BSL
ON		X		X	X	X	X		X	X
OFF	X		X					X		

DIP Switches

The following sections describe each of the DIP switches of the MCB167-NET board.

CLKCFG: Default OFF ON OFF

The **CLKCFG** switches select the clock generation. The 167 device used an on-chip PLL that generates from the external 10MHz XTAL the CPU clock signal. The following table shows the possible internal CPU clock when the standard 10MHz XTAL is used. Check the maximum possible internal CPU clock with the datasheet of actual device.

15	14	13	internal CPU clock	Note
OFF	OFF	OFF	10MHz * 4 = 40MHz	
OFF	OFF	ON	10MHz * 3 = 30MHz	
OFF	ON	OFF	10MHz * 2 = 20MHz	default setting
OFF	ON	ON	10MHz * 5 = 50MHz	
ON	OFF	OFF	10MHz	direct drive, on-chip PLL is off
ON	OFF	ON	10MHz * 1.5 = 15MHz	only possible on some CPU variants
ON	ON	OFF	10MHz * 0.5 = 5MHz	only possible on some CPU variants
ON	ON	ON	10MHz * 2.5 = 25MHz	only possible on some CPU variants

SALSEL : Default ON ON

The **SALSEL** switches define the number of active segment address lines on Port 4. For using the CAN interface only the A19..A16 address lines can be enabled, since the other Port 4 pins are CAN I/O pins. Even if some segment address lines are disabled, the device internally uses a complete 24-bit address. The full address space can be still used via the CS signals.

12	11	Segment Address Lines	Directly accessible Address Space
OFF	OFF	Two: A17…A16	256 KByte
OFF	ON	Eight: A23…A16	16 MByte
ON	OFF	None	64 KByte
ON	ON	Four: A19..A16	1 MByte (default setting)

CSSEL: Default ON ON

The **CSSEL** switches define the number of active chip select signals. The CS/ signals are generated on Port 6 and are used as chip select lines for the RAM, Flash ROM and Ethernet devices on the MCB167-NET board.

10	9	Segment Address Lines	Note
OFF	OFF	Five: CS4/…CS0/	gives two additional user CS lines.
OFF	ON	None	Port 6 pins are free; requires board modification
ON	OFF	Two: CS1/…CS0/	
ON	ON	Three: CS2/...CS0/	default setting for the MCB167-NET Board

BTYP: Default OFF ON

The **BTYP** switches select the external bus type. The MCB167-NET board uses an demultiplexed 16-bit address bus. Therefore the bus type cannot be changed without extensive modification of the MCB167-NET hardware. The following table lists the possible external bus types with the 167 CPU.

7	6	External Bus	Note
OFF	OFF	16-bit multiplexed BUS	
OFF	ON	16-bit demultiplexed BUS	default setting for the MCB167-NET Board
ON	OFF	8-bit multiplexed BUS	
ON	ON	8-bit demultiplexed BUS	

BSL: Default ON

The **BSL** switch actives the on-chip bootstrap loader. The bootstrap loader allows you to download the Monitor-166 for program debugging with µVision2. This Monitor download is automatically performed when you start the µVision2 debugger. When **BSL** is OFF you may use an Monitor program that is programmed into the on-chip ROM of the C167 device.

Configuration Jumpers

The following sections describe each of the configuration jumpers of the MCB167-NET board.

CAN1, CAN2: Default ON

The **CAN1** and **CAN2** configuration jumper enable on 120Ω termination resistor on the CAN1 or CAN2 bus interface. This resistor is used on the end of each CAN communication line.

P2.15: Default ON

The **P2.15** configuration jumper provides the interrupt request signal of the Ethernet controller to the EX7IN interrupt input of the C167 CPU.

EA/: Default ON

The **EA/** configuration jumper selects on-chip or off-chip program execution. With the default setting the CPU starts instruction execution from external memory. When the EA/ jumper is off, code execution starts from on-chip ROM.

WRCFG: Default ON

The **WRCFG** configuration jumper selects the initial operation of the WR/ and BHE/ signals. For correct operation the MCB167-NET board requires a WRH/ and WRL/ signal. Therefore this jumper should be always ON.

A20, A21, A22, A23: Default ON

The **A20…A23** configuration jumpers connect the CAN bus drivers (IC9 and IC11) to the C167 CAN interface signals. When you remove the A21 and A22 jumpers you disconnect the CAN1 bus driver. With A20 and A24 the CAN2 bus driver is disconnected.

VAREF, VAGND: Default ON

This configuration jumpers provide the reference voltage for the A/D converter. When you set this jumpers to off, you may supply an user provided reference voltage.

VPP: Default OFF

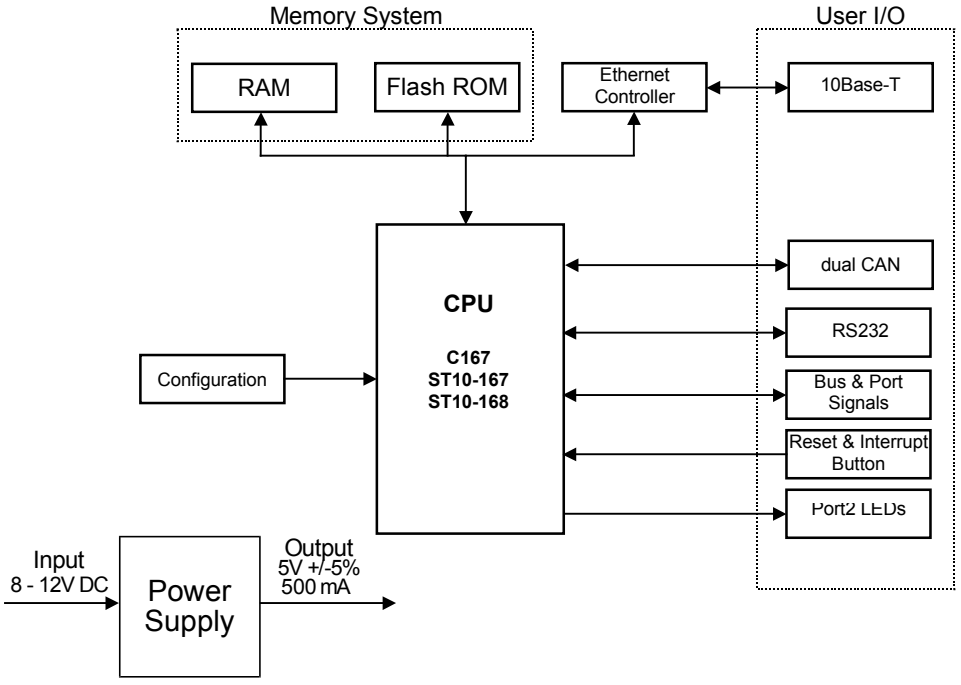
VPP provides the flash programming voltage for some devices. In some device variants. On some device variants this jumpers might be used to disable the oscillator watchdog. For detailed information about the usage of this jumper refer to the description of pin 84 in chip datasheet of the device used on the board.

Chapter 3. Hardware

The MCB167-NET is designed to be a very flexible evaluation board that you can use for a wide variety of 167 and ST10-167/168 variants. It supports up to two CAN interfaces that can be enabled using jumpers. We have also tried to provide a board that can be expanded to support your own hardware prototypes.

This chapter describes logical sections of the MCB167-NET and also provides a circuit description. The descriptions here will help you understand how the MCB167-NET board works and how you can easily interface to the various I/O devices available.

The following block diagram shows the various memory, I/O, configuration, and power systems that compose the board.



Power Supply

Power is supplied to the MCB167-NET from an external 8-12 Volt DC power supply which is capable of providing 400-500mA. Connection is made using a

standard 5.5mm barrel plug with a 2.5mm center hole. The center hole provides positive voltage. 5 Volts DC is generated and provided to the board by a 7805 voltage regulator at IC2. To reduce the noise for the A/D converter a second 78L05 voltage regulator is provided at IC6.

C167 CPU

The Infineon C167CR or C167CS provided with the MCB251 are high-end 167 devices with on-chip CAN. The CPU is located at IC1. The IC1 socket can accommodate a variants of the 167 including ST10-167/168. A 10.000 MHz crystal provides the clock signal for the CPU.

Configuration

The MCB167-NET is a very flexible evaluation board. You can change the operation of the board using the DIP switches and the configuration jumpers. Features such as CAN interfaces, chip select and segment address lines, internal CPU clock frequency, on-chip ROM usage, and Monitor operation can all be configured using these switches and jumpers. Refer to “DIP Switches” on page 9 and “Configuration Jumpers” on page 11 for a complete description of the DIP switches and configuration jumpers.

NOTE
You must RESET the MCB167-NET after changing the state of any DIP switch.

CAN Drivers

The MCB167-NET provides a dual CAN interface with SI9200AY CAN drivers (IC9 and IC11) and termination resistors (R18 and R19). The settings of this CAN drivers can be changed with various configuration jumpers.

Memory Devices

The MCB167-NET provides two high-speed RAM devices (IC5, IC8) and sockets for two Flash ROM devices (IC3, IC4). The chip select signals are directly provided by the C167 CPU: CS0/ is used for the Flash ROM; and CS1/ is the signal for the RAM.

Ethernet Interface

The Ethernet controller CS8900A (IC7) is the interface to the Ethernet connector. The MCB167-NET provides a standard 10Base-T (10MBit) interface that allows direct connection to most Ethernet networks. The chip select signal CS2/ from the C167 CPU is used to access the Ethernet controller as memory mapped device.

Decode Logic

All memory address decode logic and signal conversions required for the CS8900A Ethernet controller are performed by the 20V8 PAL (IC15). Refer to " PAL Equations" on page 17 for a complete listing of the PAL equations used.

Status LEDs

The MCB167-NET has a power LED labeled PWR which indicates the power to the board is on. Eight LEDs are connected to the Port 2 outputs for status display in user programs. The LEDs labeled LAN and LINK show the current status of the Ethernet interface.

Push Buttons

The MCB167-NET provides two push buttons. The first push button, labeled RESET, is connected to the reset input of the CPU. The second button, labeled NMI, is connected to the NMI (non-mask able interrupt) of the CPU. You may generate an NMI signal to stop program execution when you are using the Monitor-166 for program debugging.

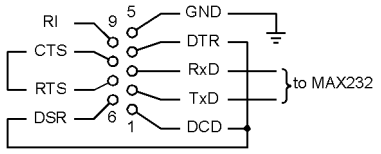
Serial Port

The MCB161-NET supports the ASC0 serial UART and uses a MAX232 (IC10) to convert the logic signals to RS-232 voltage levels. The ASC0 UART is used in bootstrap mode to download the Monitor-166 program. This Monitor program allows program test using the µVision2 debugger.

Two drivers of the MAX232 (IC10) are pre-wired to use the simulated serial mode of the Monitor-166. In this mode two standard I/O pins of the 167 device are used to establish communication between the µVision2 debugger and the

MCB167-NET board. For this operation the Monitor-166 needs to be programmed into ROM.

The serial port (COM) is configured as a standard 3-wire interface. The handshaking signals are connected to loop the PC's signals back. Refer to the figure at the right to determine how the DB9 connector for this port is wired.



Prototyping Area

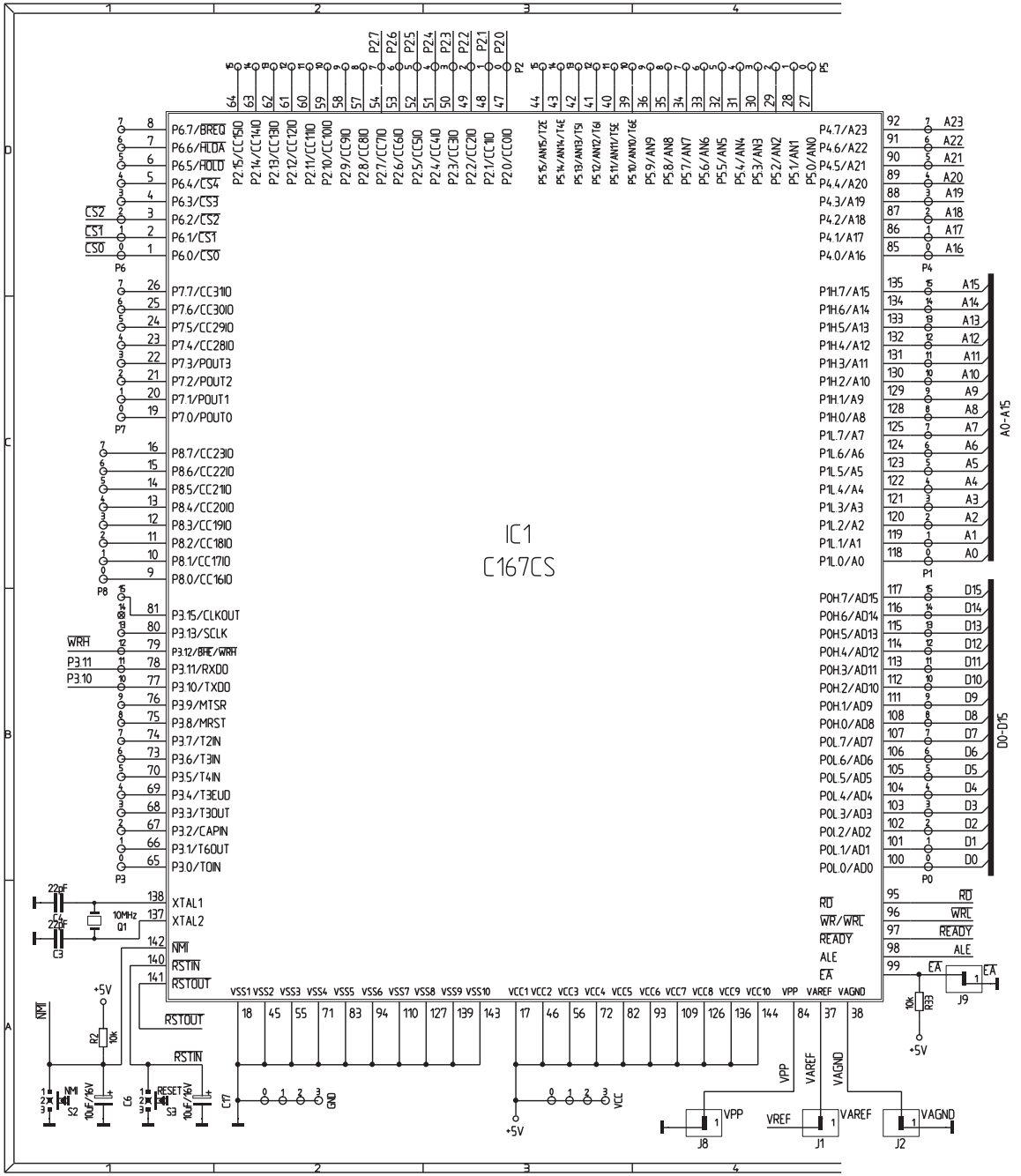
A perforated area is provided on the MCB167-NET for prototyping your own hardware. All CPU signals are connected to this prototyping area. The signals provided are driven directly by the CPU. Exercise caution to avoid overloading these signal lines. Refer to "Pin-Out of Port Signals" on page 23 for the pin-out of the CPU and bus signals.

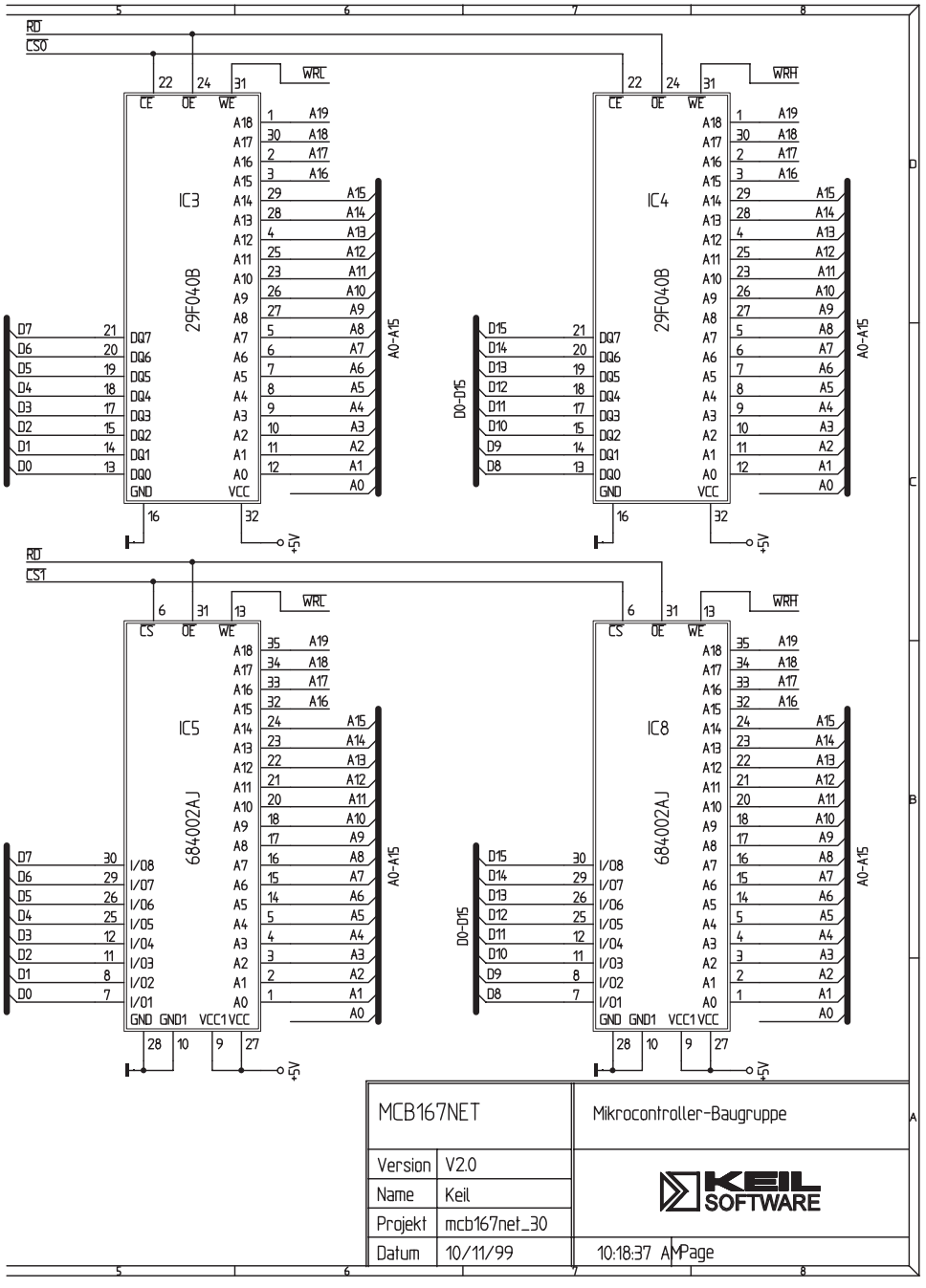
PAL Equations

This following lists the PAL equations for the 20V8 logic device at IC12.

```
;PALASM Design Description

;---------------------------------- Declaration Segment ------------
TITLE    GAL for MCB167NET Prototype board
PATTERN  Decode Logic for Ethernet Controller
REVISION 1.0
AUTHOR   Hans Schneebauer
COMPANY  Keil Elektonik GmbH
DATE     09/30/99

CHIP  IC15  PALCE20V8

;---------------------------------- PIN Declarations ---------------
PIN  1          UNUSED1             COMBINATORIAL ; INPUT
PIN  2..6       A[8..12]            COMBINATORIAL ; INPUT
PIN  7          /RD                 COMBINATORIAL ; INPUT
PIN  8          /WRL                COMBINATORIAL ; INPUT
PIN  9          /WRH                COMBINATORIAL ; INPUT
PIN  10         /RSTOUT             COMBINATORIAL ; INPUT
PIN  11         /CS2                COMBINATORIAL ; INPUT
PIN  12         GND                               ; INPUT
PIN  13         UNUSED2             COMBINATORIAL ; INPUT
PIN  14         UNUSED3             COMBINATORIAL ; INPUT
PIN  15         RESET               COMBINATORIAL ; OUTPUT
PIN  16         /IOW                COMBINATORIAL ; OUTPUT
PIN  17         /IOR                COMBINATORIAL ; OUTPUT
PIN  18         /MEMW               COMBINATORIAL ; OUTPUT
PIN  19         /MEMR               COMBINATORIAL ; OUTPUT
PIN  20         AEN                 COMBINATORIAL ; OUTPUT
PIN  21         /REFRESH            COMBINATORIAL ; OUTPUT
PIN  22         /SBHE               COMBINATORIAL ; OUTPUT
PIN  23         UNUSED4             COMBINATORIAL ; INPUT
PIN  24         VCC                               ; INPUT



;---------------------------------- Boolean Equation Segment ------
EQUATIONS

RESET = RSTOUT
SBHE  = WRH + RD
AEN   = 0
REFRESH = 0

IF (A[11..8] = #b0011) THEN     ; If in Range 0300H - 03FF -> IO Interface
  BEGIN
    IOR  = RD * CS2
    IOW  = (WRL + WRH) * CS2
    MEMR = 0                    ; MEMR always inactive
    MEMW = 0                    ; MEMW always inactive
  END
ELSE                            ; If in Range 0 - 02FF or 0400 - 0FFF
  BEGIN                         ; -> Memory Interface
    IOR  = 0                    ; IOR always inactive
    IOW  = 0                    ; IOW always inactive
    MEMR = RD * CS2
    MEMW = (WRL + WRH) * CS2
  END


;---------------------------------------------------------------------
```

Schematics


IC1
C167CS
P6.7/BREQ
P6.6/HLDA
P6.5/HOLD
P6.4/CS4
P6.3/CS3
P6.2/CS2
P6.1/CS1
P6.0/CS0
P7.7/CC31IO
P7.6/CC30IO
P7.5/CC29IO
P7.4/CC28IO
P7.3/POUT3
P7.2/POUT2
P7.1/POUT1
P7.0/POUT0
P8.7/CC23IO
P8.6/CC22IO
P8.5/CC21IO
P8.4/CC20IO
P8.3/CC19IO
P8.2/CC18IO
P8.1/CC17IO
P8.0/CC16IO
P3.15/CLKOUT
P3.13/SCLK
P3.12/BHE/WRH
P3.11/RXD0
P3.10/TXD0
P3.9/MTSR
P3.8/MRST
P3.7/T2IN
P3.6/T3IN
P3.5/T4IN
P3.4/T3EUD
P3.3/T3OUT
P3.2/CAPIN
P3.1/T6OUT
P3.0/T0IN
XTAL1
XTAL2
NMI
RSTIN
RSTOUT
P4.7/A23
P4.6/A22
P4.5/A21
P4.4/A20
P4.3/A19
P4.2/A18
P4.1/A17
P4.0/A16
P1H.7/A15
P1H.6/A14
P1H.5/A13
P1H.4/A12
P1H.3/A11
P1H.2/A10
P1H.1/A9
P1H.0/A8
P1L.7/A7
P1L.6/A6
P1L.5/A5
P1L.4/A4
P1L.3/A3
P1L.2/A2
P1L.1/A1
P1L.0/A0
P0H.7/AD15
P0H.6/AD14
P0H.5/AD13
P0H.4/AD12
P0H.3/AD11
P0H.2/AD10
P0H.1/AD9
P0H.0/AD8
P0L.7/AD7
P0L.6/AD6
P0L.5/AD5
P0L.4/AD4
P0L.3/AD3
P0L.2/AD2
P0L.1/AD1
P0L.0/AD0
RD
WR/WRL
READY
ALE
EA
VSS1 VSS2 VSS3 VSS4 VSS5 VSS6 VSS7 VSS8 VSS9 VSS10
VCC1 VCC2 VCC3 VCC4 VCC5 VCC6 VCC7 VCC8 VCC9 VCC10
VPP
VAREF
VAGND
P6
P7
P8
P3
P4
P1
P0
P5
P2
A0-A15
D0-D15
CS2
CS1
CS0
WRH
P3.11
P3.10
22pF
C4
22pF
C3
10MHz
Q1
+5V
R2
10k
NMI
S2
10UF/16V
C6
RESET
S3
10UF/16V
C7
GND
VCC
VPP
VREF
VAGND
J8
J1
J2
J9
R33
10k


RD
CS0
WRL
WRH
IC3
IC4
29F040B
A0-A15
D0-D15
RD
CS1
IC5
IC8
684002AJ
+5V
MCB167NET
Mikrocontroller-Baugruppe
Version V2.0
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Datum 10/11/99
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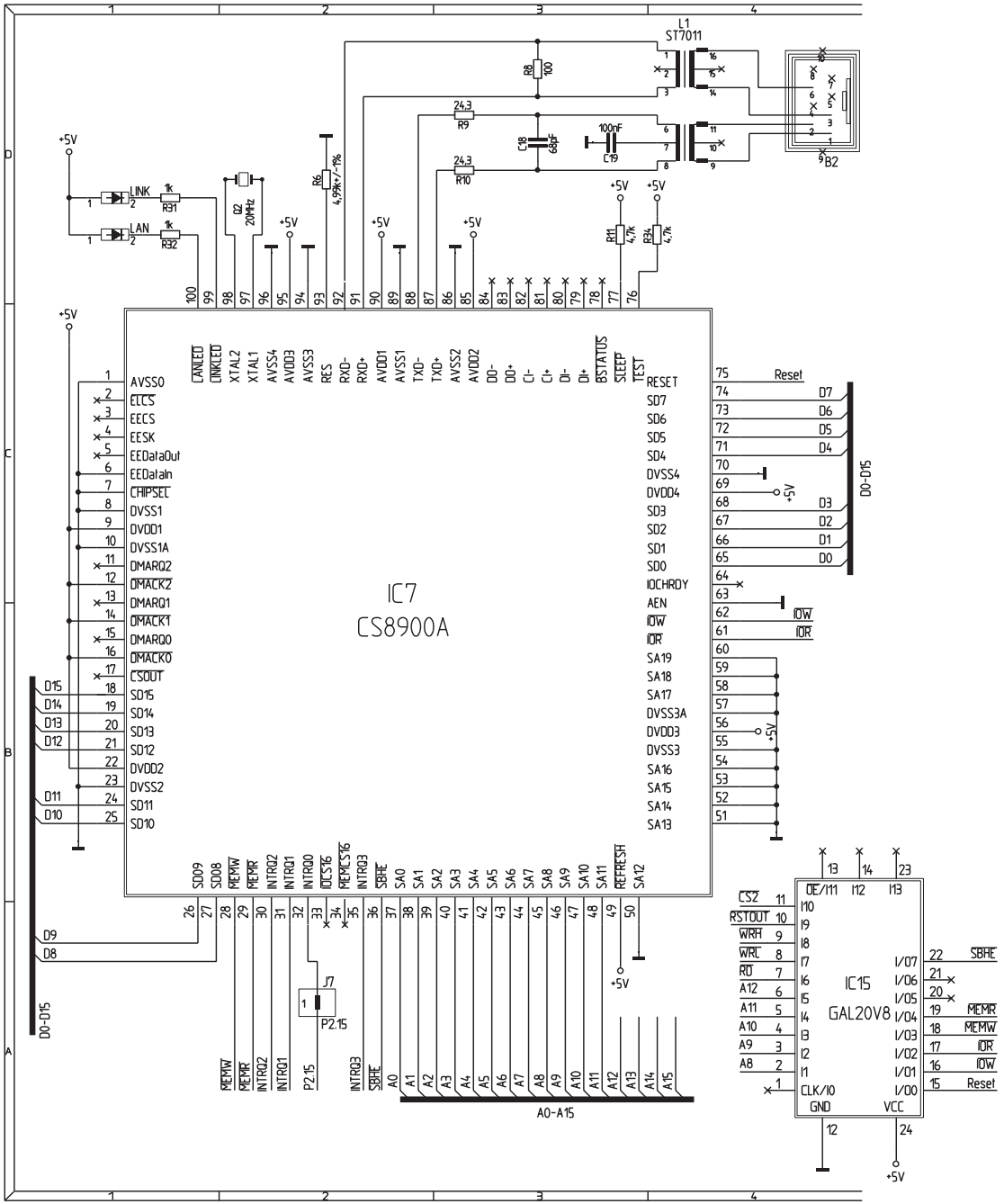
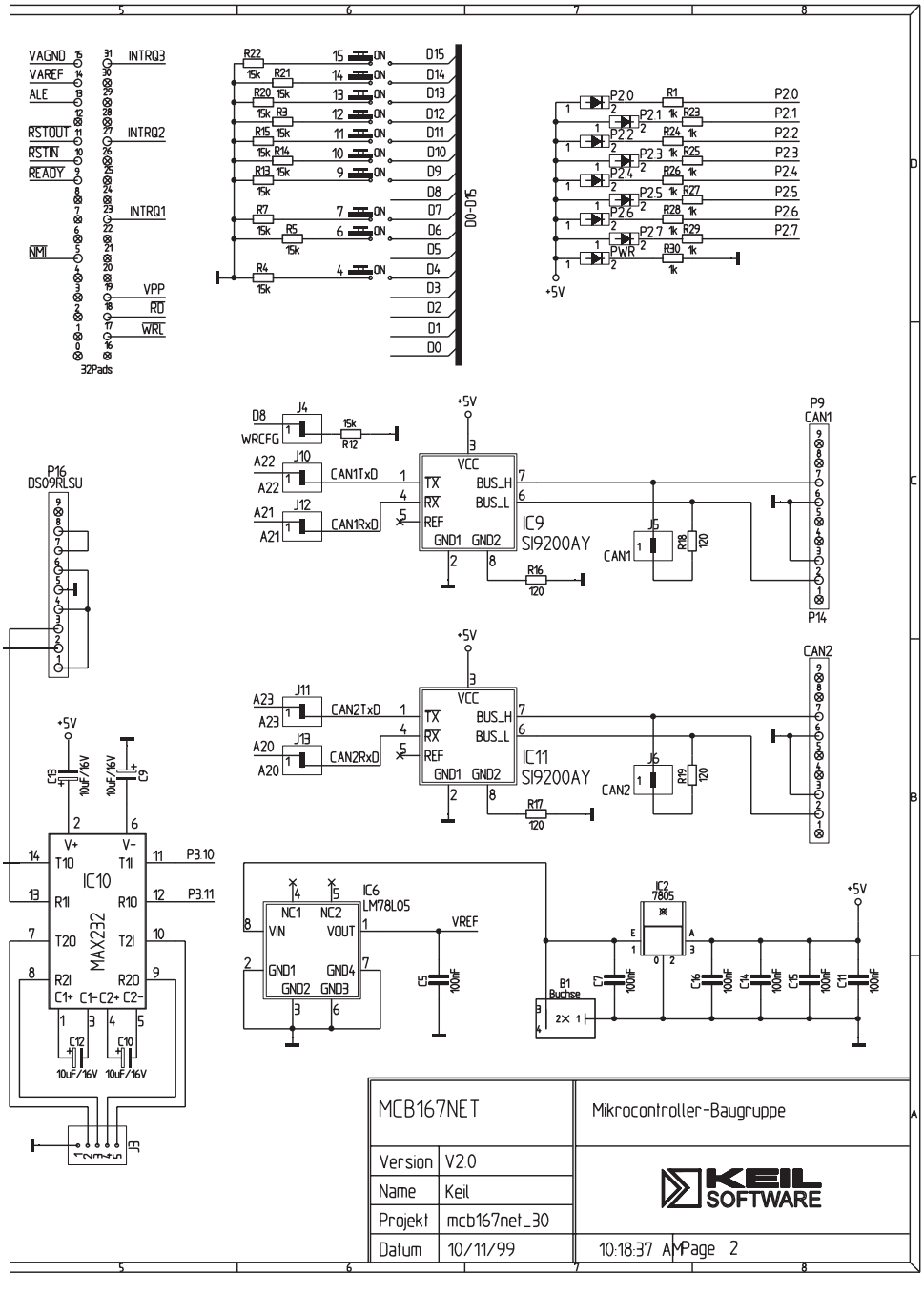

IC7
CS8900A
L1
ST7011
B2
Q2
20MHz
LINK
LAN
R31
R32
R8
100
R9
24,3
R10
24,3
C18
68pF
C19
100nF
R6
4,99K+/-1%
R11
4,7K
R34
4,7K
+5V
Reset
D0-D15
A0-A15
J7
P2.15
IC15
GAL20V8
SBHE
MEMR
MEMW
IOR
IOW


VAGND
VAREF
ALE
RSTOUT
RSTIN
READY
NMI
INTRQ3
INTRQ2
INTRQ1
VPP
RD
WRL
32Pads
D0-D15
P2.0
P2.1
P2.2
P2.3
P2.4
P2.5
P2.6
P2.7
PWR
+5V
WRCFG
CAN1TxD
CAN1RxD
CAN2TxD
CAN2RxD
IC9
SI9200AY
IC11
SI9200AY
P9
CAN1
P14
CAN2
P16
DS09RLSU
IC10
MAX232
IC6
LM78L05
VREF
IC2
7805
B1
Buchse
2x 1
MCB167NET
Mikrocontroller-Baugruppe
Version V2.0
Name Keil
Projekt mcb167net_30
Datum 10/11/99
10:18:37 AM
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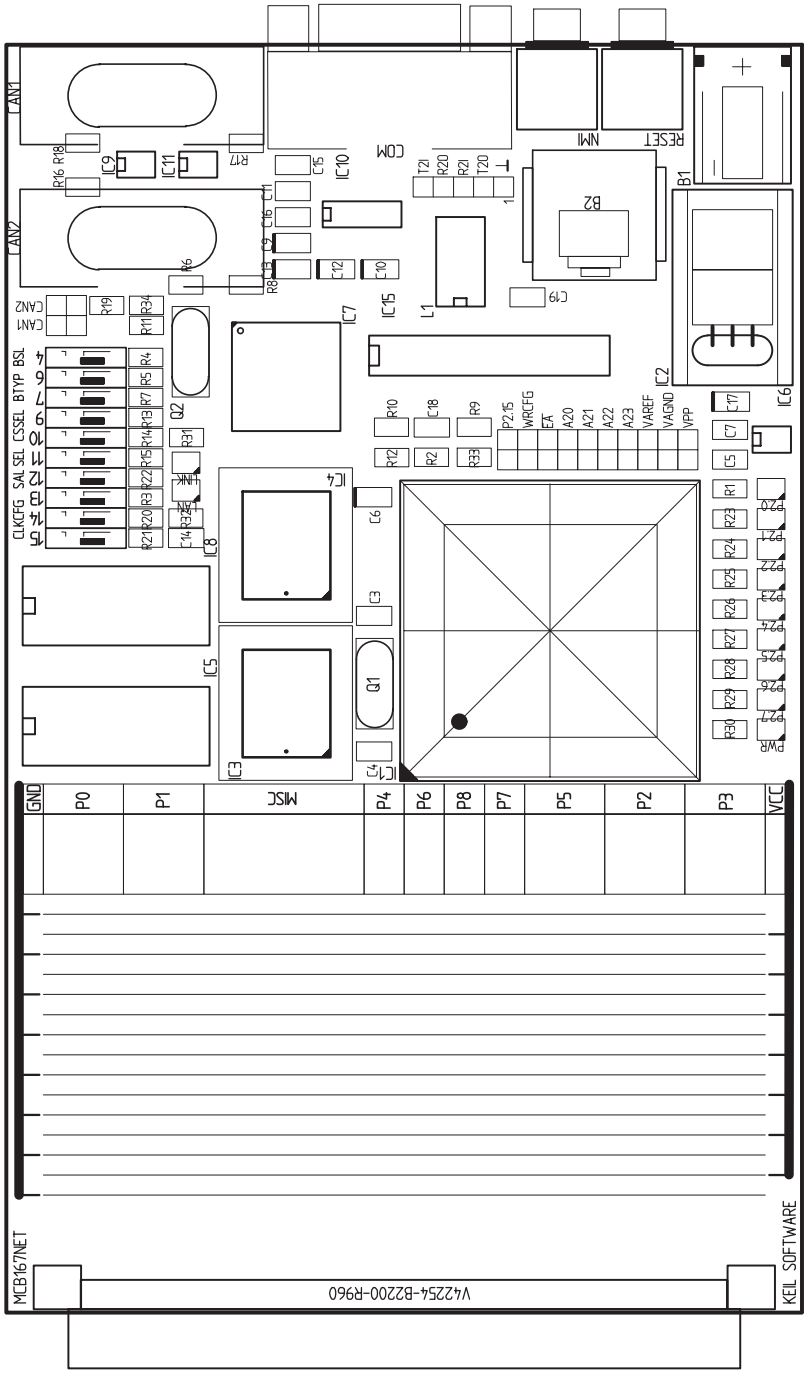
Printed Board Assembly

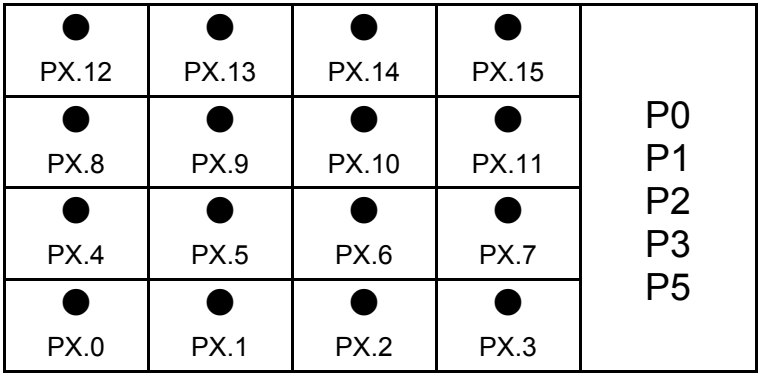


Technical Data

Supply Voltage:	8V - 12V DC
Supply Current:	typical: 400mA
XTAL Frequency:	10 MHz (allows 10MHz - 50MHz on-chip clock)
Memory:	1 Mbytes high-speed RAM (optional: 1 Mbytes off-chip Flash ROM)
CPU:	Infineon C167CR or C167CS (optional: ST Microelectronic ST10-167 or ST10-168)
Peripherals:	1 × RS232 Interface, 2 × CAN Interfaces, 1 × Ethernet Controller

Pin-Out of Port Signals

This following tables list the allocation of the Port signals that are located on the prototyping area.



Signal Pin-Out for P0, P1, P2, P3, and P5 signals

● PX.4	● PX.5	● PX.6	● PX.7	P4 P6 P7 P8
● PX.0	● PX.1	● PX.2	● PX.3	

Signal Pin-Out for P4, P6, P7, and P8 signals

●	●	●	● INTRQ3	MISC
●	●	●	● INTRQ2	
●	● EA/	●	● INTRQ1	
●	● WRL/	● RD/	● VPP	
●	● ALE	● VAREF	● VAGND	
●	● READY/	● RSTIN/	● RSTOUT/	
●	● NMI/	●	●	
●	●	●	●	

Signal Pin-Out for control signals (MISC)

Chapter 4. Programming

Writing programs for the MCB167-NET is relatively simple. The Keil Monitor-166 can be used to connect the µVision2 Debugger to the MCB167-NET board. You can use the powerful debugging interface to test application programs on the MCB-167-NET board.

The MCB167-NET board comes with a Keil Development Tools CD-ROM that contains an Evaluation Version of the Keil C166 tool chain. You should install the Keil C166 Evaluation Software or a full version of the C166 development tools.

The following section describes how to:

- Write programs with the µVision2 IDE and the C166 compiler for the MCB167-NET board.
- Translate and debug the LED Blinky example program.
- Download a program into the on-chip Flash ROM of the Infineon C167CS device.

Writing Programs for the MCB167-NET

The following steps describe the how to create and compile a µVision2 project for use with the Monitor-166 on the MCB167-NET board. You can find more information in the ***µVision2 and C166 Getting Started User's Guide*** (**C:\Keil\C166\hlp\GS166.PDF**), ***Chapter 4. Creating Applications*** and ***Chapter 5. Testing Programs***.

Start the µVision2 IDE, create a project file with **Project – New Project,** and select a CPU from the device database. The MCB167-NET board comes with the Infineon C167CR device. However, you may use also other C167 or ST10-167/168/169 devices with the MCB167-NET hardware.

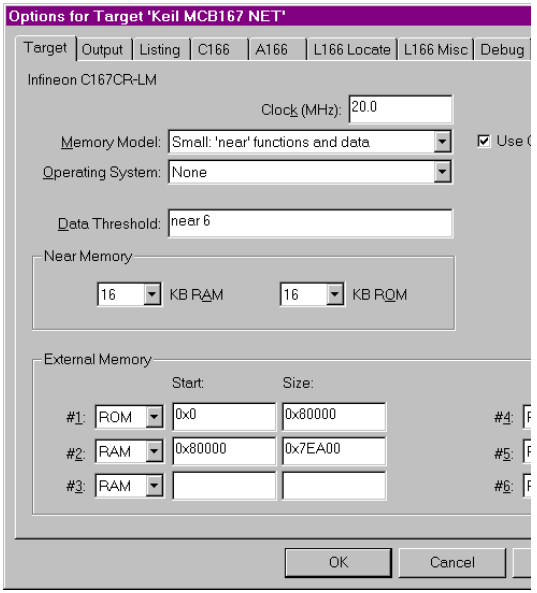
- Create a source file and add this source file to the project. This can be done in the dialog **Project – Target, Groups, Files…** or with a right click on a **Source Group** in the Project Window and the **Add Files to Group** option.
- Add and configure the startup code for the device. You may copy the file **C:\Keil\C166\Examples\Boards\Keil MCB167**

NET\Blinky\Start167.A66 to your project folder. This file is already correctly configured for the MCB167-NET board.

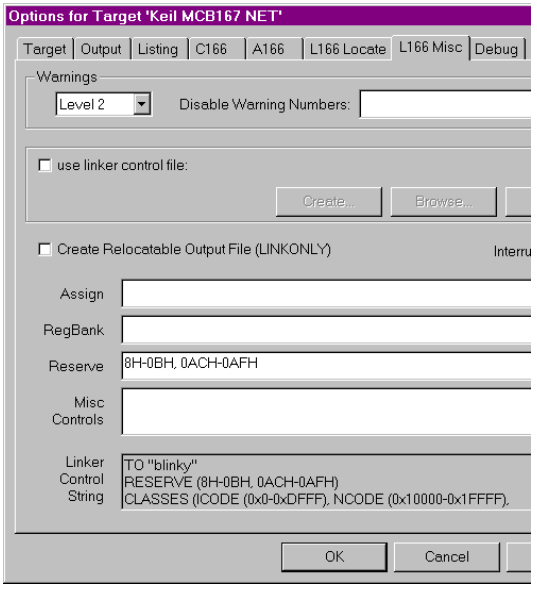
Set tool options for MCB167-NET hardware.

Project - Options for Target opens the µVision2 **Options for Target - Target** configuration dialog.

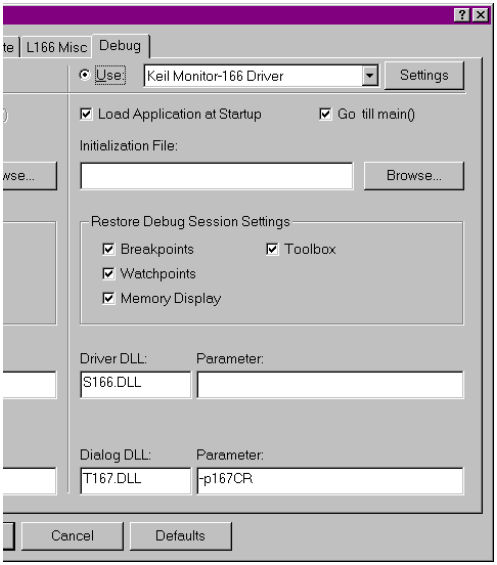
When you are using Monitor-166, the complete target application need to be stored in RAM space. Therefore you need to split the 1MByte RAM space available on the MCB167-NET into a ROM section for program code and a RAM section for data. A possible selection is shown on the right.



In the page **Options – L166 Misc** you should enter under **Reserve** the memory regions used by the MCB167-NET Monitor configuration. The required address ranges for pre-configured Monitor variants can be found under **Options – Debug – Settings – Description**.



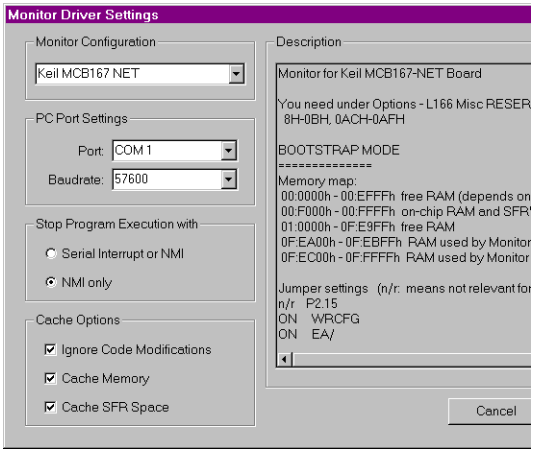
For Debugging with the Keil Monitor-166 select in the page **Options – Debug Use Keil Monitor-166 Driver**. To load and start your application when you start the debugger, you may also enable **Load Application at Startup** and **Go till main()**.



Then use the button **Settings** to open the configuration dialog for the Monitor-166.

Under Monitor Configuration select Keil MCB167 NET, configure the PC COM Port that you are using and select the baudrate. A good choice for the baudrate is 57600.

The power up the MCB167 NET board and connect the serial interface to the PC.



Build your project. µVision2 should translate all your source files and link the project.

Start the µVision2 Debugger. The debugger connects to the MCB167 NET board, downloads the monitor and the application program. In case of communication problems a dialog box opens that displays further options and instructions.

Then you may single step through your code and use other debugger features. You can find more information in the ***µVision2 and C166 Getting Started User's Guide*** (**C:\Keil\C166\hlp\GS166.PDF**), ***Chapter 5. Testing Programs***.

BLINKY Example Program

The following simple program, BLINKY, is an exercise you may use to test the MCB167-NET and verify that you can use the tools provided to generate a working program.

BLINKY blinks the LEDs on the MCB167-NET evaluation board. The complete source listing for the program is shown below:

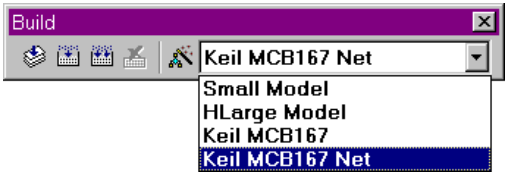
```
/* FLASH.C - LED Flasher for the Keil MCB167-NET Board */

#include <reg167.h>
#include <stdio.h>
#include <intrins.h>

void wait (void)  {                          /* wait function */
  _nop_();                                   /* only to delay for LED flashes
*/
  _nop_();
  _nop_();
  _nop_();
  _nop_();
}

void main (void)  {
  unsigned int i;                            /* Delay var */
  unsigned int j;                            /* LED var */

  DP2  = 0x00FF;
  ODP2 = 0x0000;

  while (1) {                                /* Loop forever */
    for (j=0x0001; j != 0x0100; j<<=1){      /* Blink LED */
      P2 = ~j & 0x00FF;                      /* Output to LED Port */
      for (i = 0; i < 50000; i++)  {         /* Delay for 50000 Counts */
        wait ();                             /* call wait function */
      }
    }

    for (j=0x0080; j != 0; j>>=1){           /* Blink LED */
      P2 = ~j & 0x00FF;                      /* Output to LED Port */
      for (i = 0; i < 50000; i++)  {         /* Delay for 50000 Counts */
        wait ();                             /* call wait function */
      }
    }
  }
}
```

You may build the BLINKY example program either using the µVision2 project file **C:\Keil\C166\Examples\Boards\Keil MCB167 Net\Blinky\Blinky.UV2**. Once you load this project file you can create and test the application as described under "Writing Programs for the MCB167-NET" on page 25. When you run this program it will flash the LED's on the MCB167-NET board.

Other Example Programs

The Keil C166 / µVision2 development tools contain several example programs that are configured for the MCB167-NET board. The sample programs are found in the **C:\KEIL\C166\EXAMPLES** folder. Each sample program is stored in a separate folder along with project files that help you quickly build and evaluate each sample program.

Each project contains the MCB167-NET board as a target. This target can be selected in the build toolbar as shown on the right.



The following table lists the sample programs for the MCB167-NET board and their folder names. You can find more information about the **Hello** and the **Measure** example in the ***µVision2 and C166 Getting Started User's Guide*** (**C:\Keil\C166\hlp\GS166.PDF**), ***Chapter 7. Sample Programs***.

Example	Description
Boards/Keil MCB167 Net/ Blinky	Program that blinks the LEDs on the MCB167 NET board. This program can be used to check that the Monitor-166 and the MCB167 NET board works correct.
Boards/Keil MCB167 Net/ Ethernet	Program that checks the Ethernet controller and transmits a string via the Ethernet. The string can be verified in a protocol analyzer.
Hello	Hello World program. Try this first when you begin using µVision2. It prints Hello World on the serial interface and helps you confirm that the development tools work correctly.
Measure	Data acquisition system that collects analog and digital signals.

Application Notes

Keil Software provides in addition to this User's Guide a number of Application Notes that are available on www.keil.com. For the MCB167-NET board we will develop serveral Application Notes that describe the programming of the CAN controller and an example for the Ethernet controller CS8900 that comes with this board.

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